

## CLAIMS

- 1 1. A method for separating a plurality of co-channel, interfering signals of interest  
2 received by antennas of an antenna array without any a priori knowledge of the signals, the  
3 method comprising the steps of:
  - 4 (a) forming a matrix in eigenspace based on samples of the signals received by each  
5 of the antennas of the antenna array, the matrix yielding an eigenstream for each signal of  
6 interest;
  - 7 (b) processing the eigenstreams for each signal of interest to determine a set of  
8 optimal eigenweights for each signal of interest;
  - 9 (c) converting the optimal eigenweights for each signal to beam forming weights for  
10 each of the signals of interest ; and
  - 11 (d) processing a copy of the received signals using the beam forming weights for  
12 each co-channel, interfering signal to extract each signal of interest from the received,  
13 interfering signals.
- 1 2. The method in accordance with claim 1 wherein step (b) comprises the steps of:
  - 2 (e) determining the number of interfering signals of interest from the matrix;
  - 3 (f) establishing preliminary eigenweights for each signal eigenstream;
  - 4 (g) processing each of the eigenstreams and their eigenweights to produce revised  
5 eigenweights for each eigenstream;
  - 6 (h) comparing the preliminary eigenweights to the revised eigenweights for each  
7 eigenstream to determine the differences between them;
  - 8 (i) repeating steps (g) and (h) only if the eigenweight differences exceed a  
9 predetermined value, and using the revised eigenweights from step (g) as the preliminary  
10 eigenweights when steps (g) and (h) are repeated;
- 1 3. The method in accordance with claim 2 wherein step (g) comprises the steps of:
  - 2 (j) performing time domain processing on the eigenstreams; and  
3 (k) performing frequency domain processing on the eigenstreams.

1 4. The method in accordance with claim 3 further comprising the step of:

2 (l) orthogonalizing each of the processed eigenstreams after they have been processed  
3 in steps (j) and (k).

1 5. The method in accordance with claim 4 wherein there is a beam forming network for  
2 each signal of interest to be separated from other interfering signals, each such network has a  
3 weighting circuit associated with each of the antennas of the array of antennas, the signals  
4 from each of the array of antennas are input to the associated one of weighting circuits in  
5 each of the networks, and wherein step (d) comprises the steps of:

6 (m) weighting the antenna signal input to each weighting circuit by the beam forming  
7 weights determined in step (c) for the signal of interest; and

8 (n) summing the weighted antenna signals output from the weighting circuits in each  
9 network to separate the signal of interest.

1 6. The method in accordance with claim 5 further comprising the step of:

2 (o) determining the direction from which each signal of interest is being received by  
3 the antennas of the antenna array using the beam forming weights determined in step (c).

1 7. The method in accordance with claim 6 wherein a correlation interferometer direction  
2 finding algorithm is used to determine the direction from which each signal of interest is  
3 being received.

1 8. The method in accordance with claim 6 wherein either step (j) or (k) may be  
2 eliminated when there is a priori knowledge of a received signal being a constant modulus or  
3 non-constant modulus signal.

1 9. The method in accordance with claim 5 wherein step (a) comprises the steps of:

2 (p) forming a covariance matrix using samples of the signals received by each of the  
3 antennas of the antenna array; and

4 (q) transforming the covariance matrix into the matrix in eigenspace to produce an  
5 eigenstream for each received signal of interest.

1 10. The method in accordance with claim 9 wherein the covariance matrix created in step  
2 (p) is transformed in step (q) into a matrix in eigenspace to produce a time domain  
3 eigenstream for each received signal of interest, and each eigenstream is defined by a steered  
4 eigenvector that is equal in length to the covariance matrix integration period.

1 11. The method in accordance with claim 9 wherein step (q) is performed using a  
2 conventional Hermitian matrix decomposition technique.

1 12. The method in accordance with claim 1 wherein step (b) comprises the steps of:  
2 (r) performing time domain processing on the eigenstreams; and  
3 (s) performing frequency domain processing on the eigenstreams.

1 13. The method in accordance with claim 12 further comprising the step of:  
2 (t) orthogonalizing each of the processed eigenstreams after they have been processed  
3 in steps (r) and (s).

1 14. The method in accordance with claim 13 wherein there is a beam forming network for  
2 each signal of interest to be separated from other interfering signals, each such network has a  
3 weighting circuit associated with each of the antennas of the array of antennas, the signals  
4 from each of the array of antennas are input to the associated one of weighting circuits in  
5 each of the networks, and wherein step (d) comprises the steps of:

6 (u) weighting the antenna signal input to each weighting circuit by the beam forming  
7 weights determined in step (c) for the signal of interest; and

8 (v) summing the weighted antenna signals output from the weighting circuits in each  
9 network to separate the signal of interest.

1 15. The method in accordance with claim 14 further comprising the step of:  
2 (w) determining the direction from which each signal of interest is being received by  
3 the antennas of the antenna array using the beam forming weights determined in step (c).

1 16. The method in accordance with claim 1 wherein step (a) comprises the steps of:  
2 (x) forming a covariance matrix using samples of the signals received by each of the  
3 antennas of the antenna array; and  
4 (y) transforming the covariance matrix into the matrix in eigenspace to produce an  
5 eigenstream for each received signal of interest.

1 17. The method in accordance with claim 16 wherein step (y) is performed using a  
2 conventional Hermitian matrix decomposition technique.

1 18. The method in accordance with claim 12 wherein either step (r) or (s) may be  
2 eliminated when there is a priori knowledge of a received signal being a constant modulus or  
3 non-constant modulus signal.

1 19. The method in accordance with claim 1 wherein there is a beam forming network for  
2 each signal of interest to be separated from other interfering signals, each such network has a  
3 weighting circuit associated with each of the antennas of the array of antennas, the signals  
4 from each of the array of antennas are input to the associated one of weighting circuits in  
5 each of the networks, and wherein step (d) comprises the steps of:  
6 (z1) weighting the antenna signal input to each weighting circuit by the beam  
7 forming weights determined in step (c) for the signal of interest; and  
8 (z2) summing the weighted antenna signals output from the weighting circuits in  
9 each network to separate the signal of interest.

1 20. The method in accordance with claim 19 further comprising the step of:  
2 (o1) determining the direction from which each signal of interest is being received by  
3 the antennas of the antenna array using the beam forming weights determined in step (c).

1 21. The method in accordance with claim 1 wherein the beam forming weights  
2 determined in step (c) can be used for extended periods of time and only need to be updated  
3 on an intermittent basis.

1 22. The method in accordance with claim 2 wherein the beam forming weights  
2 determined in step (c) can be used for extended periods of time and only need to be updated  
3 on an intermittent basis.

1 23. The method in accordance with claim 5 wherein the beam forming weights  
2 determined in step (c) can be used for extended periods of time and only need to be updated  
3 on an intermittent basis.

1 24. The method in accordance with claim 15 wherein the beam forming weights  
2 determined in step (c) can be used for extended periods of time and only need to be updated  
3 on an intermittent basis.

1 25. A computer readable medium containing executable program instructions for  
2 separating a plurality of co-channel, interfering signals of interest received by antennas of an  
3 antenna array without any a priori knowledge of the signals, the executable program  
4 instructions comprising instructions for:

5 (a) forming a matrix in eigenspace based on samples of the signals received by each  
6 of the antennas of the antenna array, the matrix yielding a eigenstream for each signal of  
7 interest;

8 (b) processing the eigenstreams for each signal of interest to determine a set of  
9 optimal eigenweights for each signal of interest;

10 (c) converting the optimal eigenweights for each signal to beam forming weights for  
11 each of the signals of interest ; and

12 (d) processing a copy of the received signals using the beam forming weights for  
13 each co-channel, interfering signal to extract each signal of interest from the received,  
14 interfering signals.

1 26. The computer readable medium in accordance with claim 25 wherein instruction (b)  
2 comprises instructions for:

3 (e) determining the number of interfering signals of interest from the matrix;

4 (f) establishing preliminary eigenweights for each signal eigenstream;

5 (g) processing each of the eigenstreams and their eigenweights to produce revised  
6 eigenweights for each eigenstream;

7 (h) comparing the preliminary eigenweights to the revised eigenweights for each  
8 eigenstream to determine the differences between them;

9 (i) repeating steps (g) and (h) only if the eigenweight differences exceed a  
10 predetermined value, and using the revised eigenweights from step (g) as the preliminary  
11 eigenweights when steps (g) and (h) are repeated;

1 27. The computer readable medium in accordance with claim 26 wherein step (g)  
2 comprises the steps of:

3 (j) performing time domain processing on the eigenstreams; and

4 (k) performing frequency domain processing on the eigenstreams.

1 28. The computer readable medium in accordance with claim 25 wherein instruction (g)  
2 comprises instruction for:

3 (j) performing time domain processing on the eigenstreams; and

4 (k) performing frequency domain processing on the eigenstreams.

1 29. The computer readable medium in accordance with claim 28 wherein there is a beam  
2 forming network for each signal of interest to be separated from other interfering signals,  
3 each such network has a weighting circuit associated with each of the antennas of the array of  
4 antennas, the signals from each of the array of antennas are input to the associated one of  
5 weighting circuits in each of the networks, and wherein instruction (d) comprises instructions  
6 for:

7 (m) weighting the antenna signal input to each weighting circuit by the beam forming  
8 weights determined in step (c) for the signal of interest; and

9 (n) summing the weighted antenna signals output from the weighting circuits in each  
10 network to separate the signal of interest.

1 30. The computer readable medium in accordance with claim 29 wherein the beam  
2 forming weights determined in instruction (c) can be used for extended periods of time and  
3 only need to be updated on an intermittent basis.

1 31. A method for separating a plurality of co-channel, interfering signals of interest  
2 received by antennas of an antenna array without any a priori knowledge of the signals, the  
3 method comprising the steps of:

4 (a) forming a covariance matrix based on samples of the signals incident on each of  
5 the antennas of the antenna array;

6 (b) processing the covariance matrix to generate an eigenvector for each signal  
7 incident on the array;

8 (c) multiplying measured antenna voltage data streams by the eigenvectors to develop  
9 eigenstreams;

10 (d) computing a set of optimal eigenweights for each signal;

11 (e) converting the optimal eigenweights for each signal to beam forming weights for  
12 each of the signals of interest; and

13 (f) processing a copy of the received signals using the beam forming weights for each  
14 co-channel, interfering signal to extract each signal of interest from the received, interfering  
15 signals.

1 32. The method in accordance with claim 31 wherein step (d) comprises the steps of:

2 (g) performing time domain processing on the eigenstreams; and

3 (h) performing frequency domain processing on the eigenstreams.

1 33. The method in accordance with claim 32 wherein there is a beam forming network for  
2 each signal of interest to be separated from other interfering signals, each such network has a  
3 weighting circuit associated with each of the antennas of the array of antennas, the signals  
4 from each of the array of antennas are input to the associated one of weighting circuits in  
5 each of the networks, and wherein step (f) comprises the steps of:

6 (i) weighting the antenna signal input to each weighting circuit by the beam forming  
7 weights determined in step (c) for the signal of interest; and

8 (j) summing the weighted antenna signals output from the weighting circuits in each  
9 network to separate the signal of interest.

1 34. The method in accordance with claim 33 further comprising the step of:

2 (k) determining the direction from which each signal of interest is being received by  
3 the antennas of the antenna array using the beam forming weights determined in step (e).